Newsletter of the Climate Variability and Predictability Programme (CLIVAR)

# Exchanges

Volume 4, No. 2 June 1999

## Exchanges No. 12

Contents:



## CLIVAR Scientific Steering Group - Report from the 8th Session -

*May 10 - 15, 1999, Southampton, UK*

*V. Detemmerman, JPS, J. Gould, ICPO*

The CLIVAR SSG held its 8th session at the site of the International CLIVAR Project Office (ICPO) in the busy waterfront location of the Southampton Oceanography Centre (SOC). The meeting was opened by Dr. Trevor Guymer, head of the SOC's James Rennell Division for Ocean Circulation and Climate, who welcomed all the participants to SOC which had opened its doors almost 5 years ago. He lauded CLIVAR for its emphasis on expanding our understanding of the ocean's role in climate and noted that many SOC scientists were addressing climate-related problems. He reiterated the UK commitment to CLIVAR and, in particular the ICPO, which it would continue to support at least through 2005.

Dr. Kevin Trenberth, CLIVAR SSG co-chair, led off the meeting with his perspective on implementing CLIVAR (see article page 5) and Dr. John Gould, Director of the ICPO, presented what he saw as some of the overall challenges which lay ahead for CLIVAR. These included, (1) How do we define what is CLIVAR research, or in other words What is the value-added that CLIVAR provides?, (2) How can we make CLIVAR more visible?, and (3) How can we work most effectively with GCOS and GOOS? He noted that the CLIVAR Conference in December had spurred nations to develop a frame-

The participants of SSG-8 at Southampton Oceanography Centre, UK

work for CLIVAR activities and that the challenge for the ICPO would be to capitalise on this structure and to build the national contributions to CLIVAR into a co-ordinated international programme.

The SSG expressed great satisfaction concerning the International CLIVAR Conference (see article page 5), both in its organisation and in the level of interest expressed by the many nations participating. They concurred that the challenge now was to exploit this interest to move CLIVAR implementation forward.

Presentations at the Conference by many countries pointed to the need to better co-ordinate activities which were on-going or planned in various sectors. Particularly in the Atlantic many of the PRAs and global aspects of CLIVAR had common or overlapping interests in activities such as the multi-national PIRATA moored array (VAMOS, Africa, Tropical Atlantic, etc.) or in PALACE float deployments in the North Atlantic (Thermohaline circulation, NAO, etc). Similar activities were noted in the Pacific, namely the proposed Oceanic South East Pacific Array (OSEPA) of offshore moorings, or the Japanese Triton programme, to name just two.

There was considerable discussion of what constituted the need for further implementation panels (see next article for more details), and whether to form new panels, especially since adequate funding for their operation was not currently available from international sources. It was decided that the criteria for forming a panel were met in the Atlantic, and the SSG instructed the ICPO to continue with implementation of a co-ordination Panel for the Atlantic sector. This Panel should deal with both oceanic and atmospheric issues related to all activities in the area of concern to CLIVAR and should coordinate closely with the US-CLIVAR Atlantic Panel. For the Pacific, the SSG asked that a task team be formed to consider the need for a workshop to focus on requirements and the need for co-ordination in the region. The SSG welcomed the initiative from CSIRO, Australia, to host a workshop on the Southern Ocean, and encouraged the organisers to consider all CLIVAR-related issues in the Southern Ocean, including co-ordination with the proposed WCRP programme on Climate and the Cryosphere (CLIC). Concerning the Indian Ocean sector, the SSG felt that the AA monsoon panel, in co-operation with the CLIVAR Upper Ocean Panel (UOP), should continue to co-ordinate activities in this region.

The SSG considered once again the need for / desirability of an intergovernmental panel for CLIVAR, similar to the ones for TOGA and WOCE. The general sense was that CLIVAR was such a broad programme involving so many nations and different interests, that a single panel might be too large to be effective. Instead, the SSG suggested that ad hoc resource panels might be established as required to bring together representatives of the agencies directly concerned in a given region or for a certain PRA. The SSG also agreed to keep the matter of an intergovernmental panel under review.

Dr. C. Koblinsky, chair of the UOP, gave an in depth report on the Panel's activities. He noted that in its early years, the Panel had concentrated on the observing system in the tropical Pacific in support of ENSO predictions. More recently, the focus had shifted to the gaps in global temperature and salinity coverage. The ARGO[1] concept for a global array of profiling floats had been endorsed, jointly with the Ocean Observations Panel for Climate (OOPC), and an ARGO Science Team had been formed and an implementation plan being written. Dr. Koblinsky reported that there was general optimism that the global array would be implemented. He noted that one of the major justifications for the array was to support real-time 4-dimensional data assimilation and prediction systems. The SSG urged the ARGO Science Team to ensure that there was good communication between them and other groups interested in ocean data assimilation, such as the WGSIP (Working Group on Seasonal to Interannual Prediction) and GODAE (Global Ocean Data Assimilation Experiment). The SSG noted the Panel's desire to expand its membership in order to have more expertise in DecCen and high latitude topics and agreed to take appropriate action.

Dr. A. Alexiou of the Intergovernmental Oceanographic Commission (IOC) reported on plans for the OceanObs99 Conference to be held 18-22 October 1999 in Saint-Raphael, France. The Conference was being convened by the OOPC and UOP to define an optimum mix of ocean measurements needed to meet the goals of climate programmes such as CLIVAR, GCOS and GOOS. The SSG looked forward to the outcome of this important meeting (for details see article on page 18). Dr. Alexiou also noted that there were tentative plans for a two-day GOOS commitments meeting during the IOC Assembly which would be held in June and July of this year.

Professor C.R. Mechoso reported on the many ongoing and planned VAMOS activities (for details see article on VAMOS, page 15). The SSG identified the need for an effective regional co-ordination mechanism in South and Central America to advance implementation of VAMOS and other aspects of CLIVAR research requiring participation from the region. They concluded that such co-ordination would be most effective if an ICPO staff member could have specific responsibilities for South and Central American issues and furthermore if that person could be located in the region. The ICPO and the Joint Planning Staff for the WCRP were asked to explore such a possibility.

The SSG considered that certain aspects of VAMOS pointed to the need for strong co-ordination with GEWEX activities in the region and with other WCRP groups concerned with these problems. J. Mitchell pointed out that the questions of stratus parameterisation being addressed by EPIC were of great concern to WGCM and that every effort should be made to ensure that the results from the VAMOS activities were fully translated to other aspects of CLIVAR. Professor Mechoso noted that he had been approached by members of the GEWEX community to consider how VAMOS efforts could be coordinated with an eventual GEWEX Co-ordinated Enhanced Observing Period (CEOP) which was being proposed for 2001-2. The SSG discussed at some length the merits of the CEOP as presently proposed. Concerns were raised about the timing, and particularly the availability of satellite platforms during this period, and the readiness of global models to assimilate the variables to be measured. The SSG agreed that the general concept was good and that CLIVAR should make every reasonable effort to co-operate. The ICPO was charged to compile a summary of CLIVAR activities that would likely fall within the presently planned CEOP timeframe.

C. Haas of the JPS in Geneva gave a brief overview of some Asian-Australian Monsoon Panel (AAMP) the activities, in particular the JASMINE pilot study now taking place in the Indian Ocean. Dr. Li added to her remarks concerning activities in the Western Pacific and in China. Some SSG members were concerned that certain aspects of the Panel's mandate might not be being adequately addressed. The SSG expressed interest in being briefed more fully on AAMP activities at future SSG meetings. Similar questions about co-ordination with GEWEX arose in reviewing the AAMP panel activities. The SSG saw a general need to strengthen links with GEWEX and asked the ICPO and the Co-Chairs to explore with GEWEX and the JPS for the WCRP what mechanisms might be appropriate.

The SSG welcomed the AA Monsoon Panel initiative led by Dr. I. Kang to perform an intercomparison of various atmospheric models' ability to reproduce monsoon events during the 97/98 ENSO. It noted, however, that in order to ensure the

1. Array for Real-time Geostrophic Oceanography

maximum benefit and minimum of duplication all proposed intercomparison efforts should be discussed first with the WGSIP, WGCM and/or WGNE (Working Group on Numerical Experimentation). To facilitate co-ordination, they also asked that the ICPO compile an electronic index of modelling activities and model intercomparisons in CLIVAR and link this with the related WCRP inventory which was in the making.

Professor F. Semazzi, member of the CLIVAR Africa Study Group and who has recently joined the ICPO, reported on the Group's progress. He presented extracts of the draft Science strategy which was currently under review. He noted that the lack of observational data was the single most critical obstacle to advancement in this area (see page 14). Most members of the SSG had not yet been able to review the document as a whole but they recommended that once the review process was complete, the final version should be widely distributed to interested parties, particularly WGCM, WGSIP, AA Monsoon Panel and GEWEX so they might identify activities of common interest. The SSG recommended the formation of a small ad hoc CLIVAR Africa Task Team to begin developing an implementation strategy. The Task Team would also be charged to explore links with the International Geosphere Biosphere Programme (IGBP) and to seek to broaden the base of funding support for CLIVAR Africa activities.

The SSG heard a report on the proposed WGSIP/WGCM initiative to investigate predictability of decadal variability. There was considerable debate about what the outcome might be of such an exercise, but Group members agreed that it was a worthwhile effort and encouraged the organisers to formulate a workshop programme to consider the design of an initial co-ordinated experiment on this topic. Presentations on other activities of the WGCM and WGSIP were made by Drs Mitchell and Zebiak, respectively. Drs Trenberth and Nicholls commented on the success of climate forecasts for the 97/98 ENSO period. The SSG suggested that despite the improvements in model predictions of the 97/98 event, WGSIP should place high priority on analysing the failure modes of those models so that improvements could be made.

The SSG noted with interest a report by Dr. Nicholls on the recent meeting on climate indices (Hadley Centre, UK, 2-4 September 1998) organised under the auspices of the joint CCL[1]/CLIVAR Working Group on Climate Change Detection (WGCCD). The outcome of this meeting contributed to the provision of analyses of indices of climate change, especially for the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001), but also for subsequent research and to contribute to wider efforts on climate extremes. The SSG felt that the Working Group as a whole should meet in the near future to discuss the results of work initiated at the September meeting and to plan the future activities of the Working Group. The ICPO/JPS was charged to approach the WG Chair, T. Peterson, about the possibility of scheduling such a meeting before the end of this year.

P. Holliday of the WOCE Project Office summarised the establishment of the CLIVAR DataTask Team (DTT) and in so doing presented the concept of data management based on a "data wholesaler" which would facilitate access to data sets of interest to CLIVAR researchers. The "wholesaler" would provide a search and data retrieval service across the wide range of CLIVAR data sources, making more data available to more researchers. The SSG discussed at length the benefits and potential pitfalls of such an approach. Several members had negative experiences with similar data management projects in the past and warned that CLIVAR should not launch itself into an exercise which could be extremely costly without first being assured that it had a reasonable hope of working. The SSG recommended that the CLIVAR DTT should focus its attention on PI-originated data rather than data from operational sources. With regard to the organisation of operational meteorological, satellite data and model output, use should be made to the full extent possible of existing structures which are already in place or being considered by other groups. In order to test the feasiblity of the data warehouse concept, it was suggested that the DTT identify a small user group, such as a subset of the VAMOS investigators, and develop a pilot project to meet their data requirements. The DTT was also asked to explore the feasibility of defining a set of CLIVAR standards for data delivery.

Presentations were also heard from Dr. Taylor regarding the JSC Working Group on Air-Sea Fluxes, Dr. Jouzel on CLIVAR/PAGES, Dr. Martinson on WCRP plans for a cryosphere programme 'CLIC' (Climate and Cryosphere) and Dr. Busalacchi on satellite issues. Dr. Hurrell reported on the very active US-CLIVAR programme; Dr. Hanawa gave a status

1. Commission on Climatology (of WMO)

report on Japanese CLIVAR activities and Dr. Li outlined Chinese initiatives for CLIVAR.

The SSG suggested that it was time for Exchanges to take on a slightly new look, given that many aspects of the programme were well underway and there was a need to communicate scientific results across the many disciplines and research interests represented within CLIVAR. The Group recommended that future issues should include scientific highlights of preliminary research results and summaries of recent publications. It should also feature reports of national activities and the availability of data sets.

The SSG recognised that the resources of the ICPO, both financial and human, were stretched very thin at present, and that if CLIVAR were to develop as it would like, more resources would have to be found to develop the necessary infrastructure, to hold planning meetings, to improve co-ordination with the many related programmes, etc. They urged the ICPO and the Joint Planning Staff for the WCRP, to explore all opportunities for increased support.

In summary, the SSG felt satisfied that CLIVAR implementation was moving forward on many fronts and that the expressions of national interest at the CLIVAR Conference appeared to be coming to fruition. They recognised that as implementation of the PRAs and global aspects of the programme progressed, there would be increased need for co-ordination amongst the various elements. They therefore recommended strongly that the chairs of the various CLIVAR Panels attend the next SSG meeting, which was tentatively being planned for the week of 7-11 February 2000 in Melbourne, Australia, at the kind invitation of the Bureau of Meteorology.

At the close of the meeting, the SSG thanked the ICPO (notably John Gould and Sandy Grapes) for hosting the meeting and for organising such an interesting programme of lectures, visits to ships and laboratories and dinner in the 900-hundred year old New Forest. The SSG also took time to express its deep appreciation to Dr. Allyn Clarke, who was stepping down as SSG Co-chair as of this meeting, for all he had done for CLIVAR as Co-chair for the past four years. They welcomed Prof. Jürgen Willebrand as the new Co-chair.

Dr. Jürgen Willebrand is a Professor of Oceanography at the University of Kiel, Germany, and currently director of the Department of Theoretical Oceanography at the Institut für Meereskunde. He received his Ph-D in 1973, and has previously worked at the Geophysical Fluid Dynamics Laboratory Princeton and the Max-Planck-Institut für Meteorologie Hamburg. His main research interest is the theory and modelling of ocean circulation, including inverse modelling and data assimilation, its long-term variability and its role for climate. He is author/co-author of more than 50 publications on these and related subjects, and editor/co-editor of several books. He has been a member of the international CLIVAR Scientific Steering Group since 1998.

## Perspectives on Implementing CLIVAR

*Dr. Kevin E. Trenberth, Co-chair SSG*

This has a been a year of major accomplishments in CLIVAR as we move more solidly toward implementation, yet it seems that the more we achieve the more there is to do! The following is a brief perspective on where I believe we are at. In the past year we have completed the Initial Implementation Plan, published and distributed it, and held the major International CLIVAR Conference in Paris, in December 1998. The latter was very successful and brought rousing interest from the 63 countries represented, while also providing an incentive for nations around the world to think more seriously about CLIVAR and organise their own contributions. A lot of credit goes to the organising committee and the speakers, but I especially want to thank John Gould and the ICPO for their diligent work that guaranteed success, and David Carson of the UK Met. Office for chairing the meeting.

Through the process of building a scientific consensus on what CLIVAR should focus on, and the events in 1998, a great deal of momentum was built up for CLIVAR. Mike Hall of NOAA in the United States, in a stirring closing address at the conference, commended CLIVAR on this but pointed out the need to capitalise on the momentum as we now move ahead. This is not easy. The devotion of all the resources of the ICPO to the conference, meant that actual implementation of the CLIVAR plan was set aside, and the huge scope of CLIVAR is a major challenge for us all. Some parts of CLIVAR are well underway, notably those initiated in TOGA and carried on under a CLIVAR banner, and WOCE synthesis activities are of central interest to CLIVAR as well. Infrastructure established from TOGA such as observing systems like the Tropical Atmosphere-Ocean (TAO) moored buoys in the tropical Pacific, seasonal forecast activities at national centres and the International Research Institute (IRI), and global numerical modelling help enormously. Nevertheless, the ICPO is clearly stretched to the limit to deal with all that is required.

So the focus now switches to implementation of CLIVAR, and much of this has to be accomplished through the standing Working Groups and Panels, as well as several new implementation panels in the formative stages, while being co-ordinated through the CLIVAR SSG and cross-cutting working groups such as the Working Group on Coupled Modelling (WGCM), Working Group on Seasonal to Interannual Prediction (WGSIP), the Upper Ocean Panel (UOP), and the CLIVAR-PAGES[1] Working Group. The working groups on numerical experimentation are global in scope but differ in the time scales of their foci. Paleo-data and reconstructions and syntheses of the past climate and its variability on all time scales are pertinent to all CLIVAR activities. Similarly, the UOP will have a global focus on ocean observations on all time scales and in ensuring that observations carried out under other programmes, such as the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS), also meet the needs of CLIVAR while helping to justify those observations. The ICPO has as a primary responsibility to co-ordinate the international CLIVAR activities while the SSG provides the overall scientific guidance and co-ordination among panels.

1. Past Global Changes (IGBP project)

The CLIVAR SSG discussed at some length the needs and reasons for having panels. We have as a basic tenet the desire to keep the number of panels to a minimum. However, it was agreed that 1) When there are multiple national activities in an area relevant to and nominally for CLIVAR that require co-ordination, then there is a strong need for a panel; and 2) Such a panel should be an advocacy group for the implementation of the PRAs and parts of CLIVAR to increase the funding and resources available to achieve the objectives, and to direct observations, funds and other activities that may not be labelled “CLIVAR” to help achieve CLIVAR objectives.

At the current time we are exploring three new implementation panels, and while these will have regional foci, their objectives are to carry out the research necessary to address the scientific objectives of the Principal Research Areas of CLIVAR, including both atmospheric and ocean domains, and intersections with other parts of the World Climate Research Programme (Global Energy and Water Cycle Experiment (GEWEX), Arctic Climate System Study (ACSYS), Climate and the Cryosphere (CLIC), Stratospheric Process and their Role in Climate (SPARC), and the World Ocean Circulation Experiment (WOCE)). One such panel will be focused on the Atlantic and will encompass PRAs D1, D2 and D3, plus extensions into the South Atlantic. Another will likely focus on the Pacific (D4 and G1), while possibly a third on the southern oceans (D5) should interact strongly with the developing CLIC programme. At present the Indian Ocean is considered part of the domain of the Asian-Australian Monsoon Panel. With the new report from the African task group nearly completed, follow-on activities are also expected for Africa. It should be noted that at present there are NOT adequate funds to support these panels and their meetings, and hence the need is strong for the panels to publicise CLIVAR, take advantage of local national interests, and raise the requisite funds to support their activities.

While there are multiple challenges for CLIVAR ahead, the progress has been enormous and the enthusiasm of the scientists is infectious. I want to especially thank Allyn Clarke, who has been my co-chair of the SSG over the past three years but who has now stepped down and welcome Jürgen Willebrand (see previous item, page 5) who is now helping to lead the CLIVAR SSG.

## The WCRP Joint Scientific Committee - 20th meeting (JSC-XX) -

*March 15-19, 1999, Kiel, Germany*
*Dr. John Gould (ICPO), Dr. Kevin Trenberth (SSG Co-Chair)*

This meeting is the annual one at which all strands of WCRP are brought together and reviewed by the JSC. The meeting was held in the fine surroundings of the Art Gallery across the road from the Institut für Meereskunde who generously hosted the meeting. A welcome local flavour was added by a reception held on the research ship Alkor.

Each component project (CLIVAR, GEWEX, SPARC, ACSYS and WOCE) and WCRP-wide modelling activity (Working Groups on Numerical Experimentation - WGNE and on Coupled Modelling - WGCM) reported as did the joint WCRP/SCOR Air-Sea Flux working group. The JSC also considered interactions with related activities like the International Geosphere-Biosphere and Human Dimensions Programmes (IGBP and IHDP).

CLIVAR's impact was immediate since the meeting room was decorated with Andreas Villwock's wonderful "PRA Posters". These were much-admired, much-read and were taken away at the end of the week by the attendees.

CLIVAR's presentation was headed by Kevin Trenberth with additional input from John Gould. To augment the overview of the International CLIVAR conference in Paris in December 1998, which many of the JSC attended, and the 14 posters, the CLIVAR presentation focused on three science topics. These were (i) VAMOS, the planned field campaigns, and implementation issues; (ii) synthesis of reconstructions of the climate of the past millennium as supported by the CLIVAR-PAGES WG, and (iii) an update on the 1997-98 El Niño event and resulting issues for CLIVAR (see Exchanges vol 3, number 2: **http://www.dkrz.de/clivar/exchv3n2p1.html#ENSO97** for a preliminary report).

The main issues relating to CLIVAR are the following (Many were considered again at the CLIVAR SSG meeting - see report page 1)

- It was noted that CLIVAR needed to intersect with ACSYS and the new Climate and Cryosphere (CLIC) project. This will be of importance when implementing PRA D5 (Southern Ocean Climate Variability)

- The IGBP synthesis phase will end with a big science conference in Amsterdam in June/July 2001. In particular there is a proposal to have a session at the conference on ENSO impacts linking WCRP, IBGP and IHDP. An additional CLIVAR link to IGBP is via WGCM and IGBP's GAIM (Global Analysis Interpretation and Modelling) activity, since many modelling groups include not only the physical climate system but also biogeochemistry in their research and numerical experimentation.

- WCRP projects have all been asked to document their links to IGBP. In CLIVAR there are formal links with PAGES and through providing the physical underpinning of many of IGBP's activities.

- GEWEX plans to have a CEOP (Co-ordinated, Enhanced Observing Period) in 2001-2 to coincide with the availability of new earth observing satellites. This was seen by JSC as a possible means of focusing and co-ordinating other WCRP/GOOS/GCOS activities. CLIVAR will ask all of its panels and WGs to see what can be done to contribute to the CEOP.

- The SCOR/WCRP Working Group on Air-Sea fluxes (Chaired by Peter Taylor (SOC, Southampton) and Serge Gulev (IORAS, Moscow)) has been asked to complete its report by the end of 1999 so that it may be considered by the JSC at its next meeting.

- There was discussion of the formation of an Intergovernmental Board for WCRP, for CLIVAR, or jointly with GCOS, and this was referred to the CLIVAR SSG (see page 2 for further discussion).

- CLIVAR joined WOCE in composing a letter on the importance of altimetry and scatterometry for both projects. The text of this letter is given below.

- Berrien Moore III (Chair Scientific Committee International Geosphere Biosphere Programme (IGBP)) was extremely complimentary about the CLIVAR Conference particularly in respect of the level of enthusiasm and commitment shown by the delegates who stayed right to the end!

***Letter sent by Director, WCRP Prof. Dr. H. Grassl***

*to*

***Dr. T. Mohr, Director, EUMETSAT***
***Prof. D. Southwood, European Space Agency***
***Dr. G. Brachet, Centre National d'Etudes Spatiales***
***Mr. Y. Haruyama, NASDA***
***Dr. D. James Baker, US Under Secretary for Oceans and Atmosphere***
***Dr. D. Goldin, NASA Headquarters***

***Subject: The Future of Satellite Altimetry and Scatterometry***

*At its twentieth session held recently, the Joint Scientific Committee for the World Climate Research Programme (WCRP) discussed the importance of satellite altimeter and Scatterometer measurements for the understanding and prediction of climate and specifically for the success of its projects. The Committee requested me to relay our experience to date and requirements for the future to the major space agencies.*

*The World Ocean Circulation Experiment (WOCE), with its goal of collecting the data necessary to test ocean models has relied a great deal on the satellite missions of the 1990s. Moreover, determining the representativeness of the specific WOCE data sets relies on continuing satellite missions throughout the next decade. Progress towards these goals has benefited significantly from the outstanding success of the TOPEX/POSEIDON altimeter mission, including particularly the unique description provided of ocean variability on a wide range of space and time scales, the understanding of ocean circulation on the largest scales, the testing and improvement of global circulation models and the assimilation of altimeter data in global models to estimate the current ocean state.*

*Our ability to force ocean models, and to evaluate the surface forcing of coupled models, has been radically improved by the advent of scatterometers on ERS-1 and ERS-2, and NSCAT on ADEOS. However, the small swath width of the ERS scatterometers and the short duration of the ADEOS flight mean that the full potential of scatterometry has not yet been realised. Success in the data assimilation area will, in the near future, allow specific hypotheses of the processes controlling ocean circulation to be tested and climate models to be initiated for decadal climate prediction. These advances will not be possible with in situ data alone.*

*The TOGA and CLIVAR projects have also benefited significantly from improved description and understanding of ENSO events both by new in situ and satellite data. This research has now progressed to the stage where altimeter and scatterometer data are already being utilised in seasonal to interannual predictions, which are of increasing societal relevance. Scope exists for expanding this role from the tropical Pacific to the other tropical basins. The altimeter data provide additional information beyond that available from the in situ observational network. The scatterometer data are the only source of vector winds over large parts of the world's oceans.*

*The successes of satellite altimetry could only have been achieved with the highest quality instruments and processing (e.g., TOPEX/POSEIDON). Of particular importance has been the rapid improvement of the quality of data resulting from activities leading up to the launch and the subsequent developments during the missions. Important elements contributing to this success include the interaction of Science Working Teams with NASA and CNES and the commitment to quality and leading edge technology by NASA and CNES. The quality achieved, together with the recent advances, offers the prospect that, with the correct support, satellite altimetry will continue to improve through the JASON-1 mission and beyond. During this period new technologies that will be important for future operational altimeter missions will almost certainly emerge.*

*The WCRP experience to date indicates that the highest quality altimeter and scatterometer data will remain vital ingredients throughout the CLIVAR study and beyond. The data will be an increasingly important element for the development and validation of models required for the prediction of seasonal to interannual climate variability, the timing and the regional impact of anthropogenic climate change as well as understanding and predicting decadal climate variabil-*

*ity and, of course, the determination of long-term sea-level change. Along with in situ data from projects like ARGO, it is also essential for the success of the Global Ocean Data Assimilation Experiment (a global project emerging from the IGOS pilot projects) that is likely to revolutionise our understanding of how to observe the ocean).*

*Of equal importance to the quality of satellite altimeter and scatterometer data is their continuity. As well as continuous oceanographic time series, overlapping missions allow cross-calibration of individual sensors and total system accuracy, as is proving critical for many other satellite systems. In addition, such overlapping missions significantly enhance the sampling, enabling otherwise intractable physical processes to be investigated on a global scale.*

*On behalf of the WCRP, I would strongly encourage space agencies to continue to commit to the development and continuity of high quality satellite altimeter and scatterometer missions after JASON-1, ADEOS-II and ENVISAT, until operational missions of comparable quality can be assured. A research quality satellite altimeter mission beyond JASON-1 may well provide the stepping stone to such future operational missions. Similarly, a high quality scatterometer on ADEOS follow-on missions would provide a bridge to operational scatterometers as part of the foreseen USA National Polar-orbiting Operational Environment Satellite System, NPOESS, and would complement ESA's ASCAT on METOP.*

*To ensure the connections with the operational space agencies it would seem appropriate to involve NOAA and EUMETSAT in the planning of future satellite altimeter missions. I also ask all space agencies to continue the development of new satellite altimeter and scatterometer technologies, especially those that will lead to high quality operational products in the future.*

*Yours sincerely,*

*Prof. Dr. H. Grassl*
*Director, World Climate Research Programme, Geneva, Switzerland*

## Development of a Regional Climate Model for Eastern Africa

*Dr. Fredrick Semazzi, ICPO, Southampton, UK**

It is now well established that high resolution regional climate models driven by time-dependent meteorological lateral boundary conditions (LBC) can be used successfully to downscale climate simulations generated from the relatively coarse resolution global models (Giorgi and Mearns, 1999). However, before full benefits of this approach may be realised, major research investment is required to address the remaining modelling problems. These include, (i) the spin-up problem, (ii) compatibility between the regional and global model physics, (iii) optimal choice of domain and resolution, (iv) minimisation of the negative effects due to the discontinuities associated with the LBC, and (v) exploration of the prospects for the adoption of the two-way nested approach. Equally important, there is need to clarify if the skill of climate prediction is preserved or enhanced in the nested models.

During the recent years, there has been rapid increase in the use of the nested models for a wide variety of climate-related applications for all the continents of the world. In this report, we briefly describe some of the recent modelling developments based on the application of the nesting approach over eastern Africa. The research activities described in this report represent work in progress at the Facility for Ocean/Atmosphere Modelling and Visualization (FOAMV), at North Carolina State University, USA. The basic regional climate model used in this investigation is the National Center for Atmospheric Research (NCAR) numerical Regional Climate Model (RegCM2; Giorgi et al., 1993), adapted for eastern Africa (Sun et al., 1999a,b). The earlier version of the model was employed to study the climate variability of western Africa (Semazzi et al., 1993). The customized model is applied to a region over eastern Africa (5580 km x 3700 km) centred over lake Victoria. The horizontal grid spacing of the model is 60 km, both, in the east-west and north-south directions. In the vertical, the atmosphere is stratified into 15 layers. The model's initial and lateral bound-

*) Permanent Affiliation: North Carolina State University Department of Marine, Earth & Atmospheric Sciences P. O. Box 8208, Raleigh, North Carolina 27605-8208, USA.

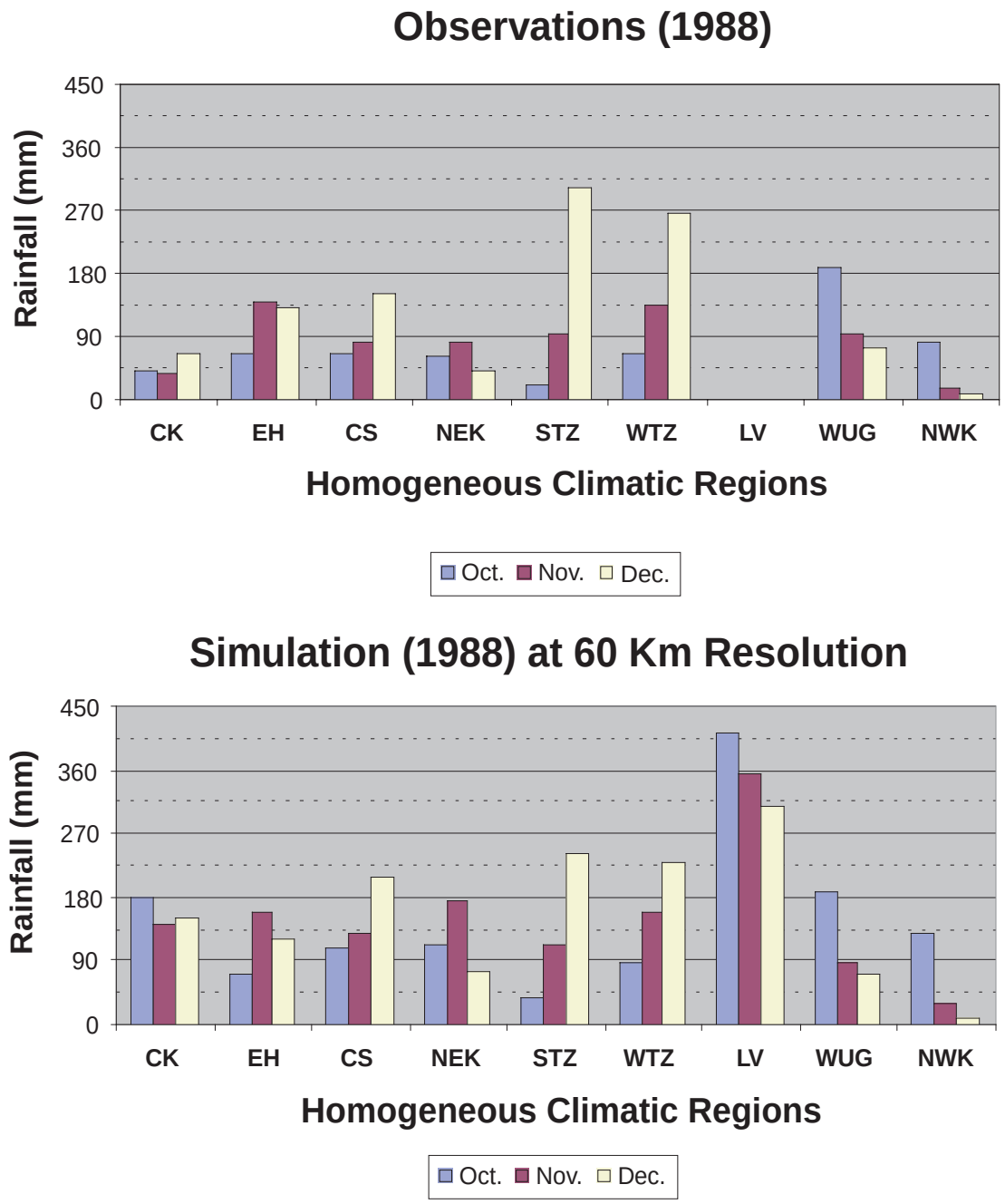



Figure 1: Observed (top panel) and Regional Climate Model simulated (lower panel) precipitation over eastern Africa for October, November and December 1988. Based on these results, we have reasonable confidence that the regional climate model is also realistically reproducing the rainfall over lake Victoria (LV), but high resolution observations over the lake are needed to validate the model results. The nine climatic regions which are based on cluster analysis, are as follows: CK - Central Kenya, EH - Eastern highlands of Kenya, CS - Coastal strip of Kenya and Tanzania, NEK - Northeastern Kenya, STZ - Southern Tanzania, WTZ - Western Tanzania, LV - Lake Victoria basin, WUG - Western and central Uganda, and NWK - Northwestern Kenya and parts of northeastern Uganda.

ary conditions are taken from European Center for Medium Range Weather Forecasting (ECMWF), 12-hourly, analysed atmospheric observational data. The representation of the lake in the standard version of the RegCM2 model is based on the 1-dimensional heat transport formulation. In this treatment, heat from the Sun's radiation which arrives at the lake surface penetrates the interior of the lake along vertical columns of water and does not mix horizontally. As shown later, we have found that upgrading of the model formulation to incorporate the 3-dimensional dynamical effects, and hence allow for horizontal mixing of heat and momentum is important.

To evaluate the climate model's performance in reproducing the observed precipitation over eastern Africa, regional averages of simulated and observed precipitation are compared in Figure 1 over nine homogeneous climate subregions, constructed by Indeje et al. (1999), based on cluster analysis techniques. A striking feature of the comparison between the computer generated and the observed rainfall is that the model reproduces the month-to-month tendencies (increase or decrease) of the rainfall for all the 9 regions. This demonstrates the ability of the model to resolve the complex migration patterns of the Inter-Tropical Convergence Zone (ITCZ) over such complicated terrain, vegetation, and land-water contrasts over eastern Africa. Contemporary global climate models cannot produce such geographical details because of their coarse resolution. We consider this performance of the regional climate model as an important step toward the application of RegCM2 in the prediction of the climate of the region. The model also reproduces the day-to-day and year-to-year changes (not shown) in rainfall over the catchment region of lake Victoria (Sun et al., 1999a,b). Furthermore, we have also compared the diurnal variations of the rainfall at several locations around the lake (not shown). The model accurately reproduces the observed diurnal asymmetries in the rainfall distribution over and around lake Victoria. Recent advances in the estimation of the rainfall over lake Victoria, based on remote sensing (Ba and Nicholson, 1998; and Yin and Nicholson, 1998), will be exploited in the future to validate the model results.

As a major component of this study, we have recently developed a new model for lake Victoria which incorporates the effects of the 3-dimensional water circulation and heat mixing. Relatistic representation of lake Victoria is important because of its size and regional hydrological implications. Lake Victoria is the second largest fresh water lake in the world and it is also the source of the river Nile. As such, it has profound influence on the social-economic activities over a large section of Africa.

More specifically, the 3-D lake model is based on the Princeton Ocean Model (POM) (Mellor, 1997) with grid spacing of 20km in both horizontal directions. The model equations are essentially the same in form, as the ones typically used in the design of the global ocean climate models. A variety of modifications have been implemented to transform POM into a closed freshwater lake model for lake Victoria (POM-V). Several test experiments have been conducted using POM-V to simulate the lake's circulation during the rainy season of eastern Africa from October to December 1988. The meteorological forcing for POM-V is based on output from the double-nested Regional Climate Model (RegCM2), which has been described above. A number of model sensitivity experiments have been conducted to investigate the performance of the model. Below, we summarise some of the recent results based on POM-V.

Figure 2 (page 12) shows the December climatological mean for the near-surface winds which were applied at the top of the lake model. The flow is dominated by the easterly surface prevailing winds, as expected at this time of the year. These data were obtained from a previous run of the regional climate model (RegCM2) coupled to a simple 1-dimensional representation of lake Victoria. Figure 3 (page 12) shows the December 1988 mean surface water circulation and temperature produced by the 3-dimensional lake Victoria model (POM-V). The figure displays the lake's surface temperature, and the arrow vectors represent the surface water currents. The lake surface circulation is characterised by anti-clockwise circular motion in response to the predominantly easterly surface winds shown in Figure 2. The close agreement between the surface water circulation pattern (Figure 3) and the topography of the lake (Figure 4, page 13), indicates that it may play a significant role in determining the climatology of lake Victoria. The relative role of the dynamics and thermodynamics responsible for this model response is under investigation. Comparing with the corresponding results based on the simple 1-dimensional lake model (not shown) in the standard regional climate model (RegCM2), the 3-

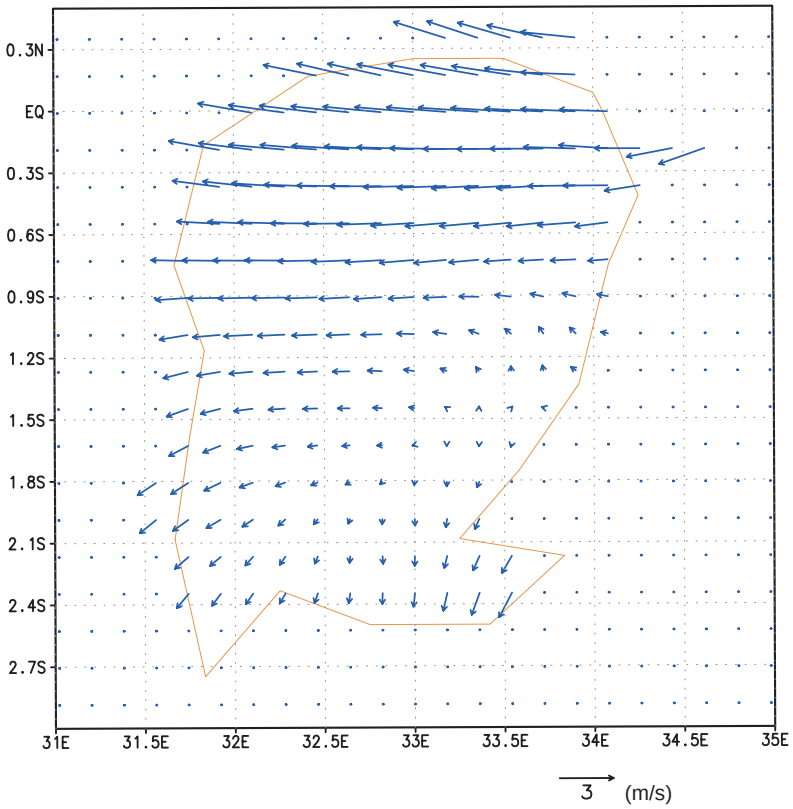



Figure 2: December, RegCM2 generated, climatological mean for the near-surface winds (m/s) which were applied at the top of the lake model.

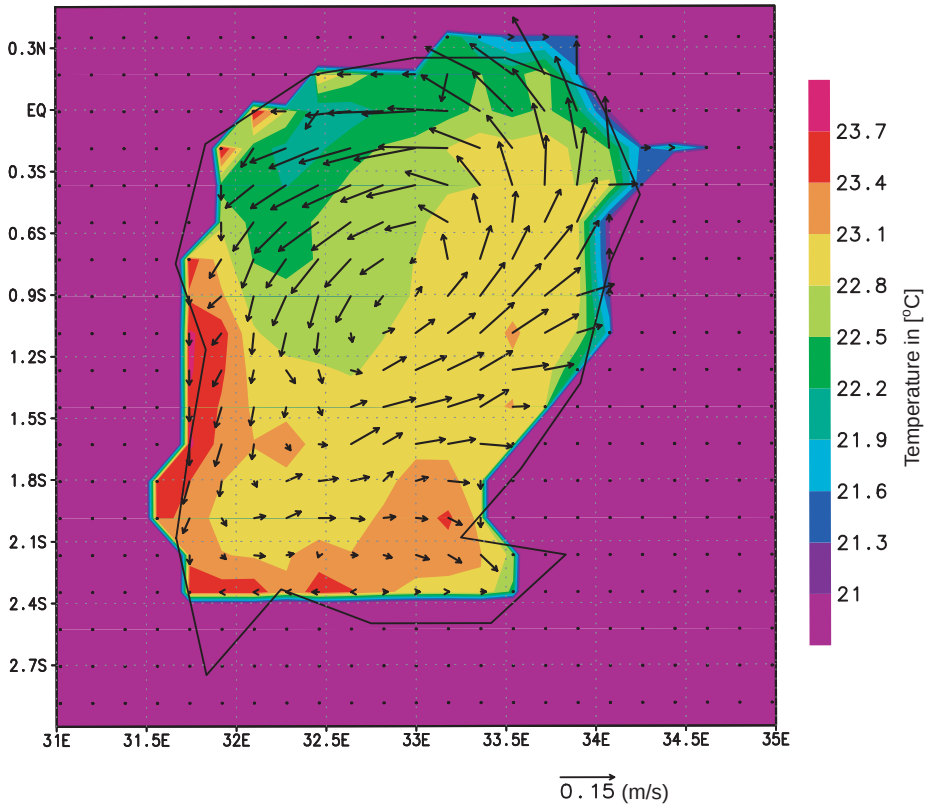



Figure 3: Lake Victoria model (POM-V) results for the December 1988 mean surface water circulation in meters/second, and temperature (see scale in °C, above).

dimensional lake model clearly produces superior results. In particular, the 3-dimensional model produces a surface temperature pattern indicative of horizontal lake water mixing characterised by a horizontal spiral pattern in the temperature field. This is associated with the spreading of the pool of warm water across the northern section of the lake. This pattern is not present in the 1-dimensional model (not shown).

These results underscore the merits for upgrading the 1-dimensional formulation of the lake model in the standard regional climate model (RegCM2) to the new 3-dimensional lake model. Based on RegCM2 coupled to the 1-dimensional lake, we have also observed (not shown), that the region of maximum rainfall tends to be co-located with the migration of the warm water pool during the course of the season (October-December). Since the "stand-alone", 3-dimensional lake generates more realistic lake water surface temperature patterns than the corresponding 1-dimensional model, we postulate that the coupled RegCM2/3-dimensional lake model (when its construction is completed), will produce more realistic rainfall patterns over and around the lake than in the present results. Comparison of the diurnal surface winds and surface water circulation reveals an important phenomena. Although the surface winds reverse direction during the course of the day in association with the land/lake breeze (not shown), and also dominate the total wind field, the water circulation maintains the same anti-clockwise circulation throughout the day, similar to the mean flow shown in Figure 3. This observation re-enforces the proposition that the circulation of the lake is primarily controlled by the prevailing wind forcing rather than the component associated with the land/lake breeze. We postulate that the large inertia associated with the water is responsible for the weak response to diurnal cycle which dominates the near-surface wind regime.

In summary, we reiterate that the ultimate goal in this research investigation is to develop a regional climate model to study the variability and predictability of the regional climate of eastern Africa across a broad range of time scales. Recent results indicate that introduction of a comprehensive 3-dimensional dynamical lake model, as a component of the regional climate model could open up new prospects for resource management applications, such as: (i) prediction of fish environments and population dynamics in lake Victoria, (ii) prediction of lake transport of potentially highly toxic chemical affluent

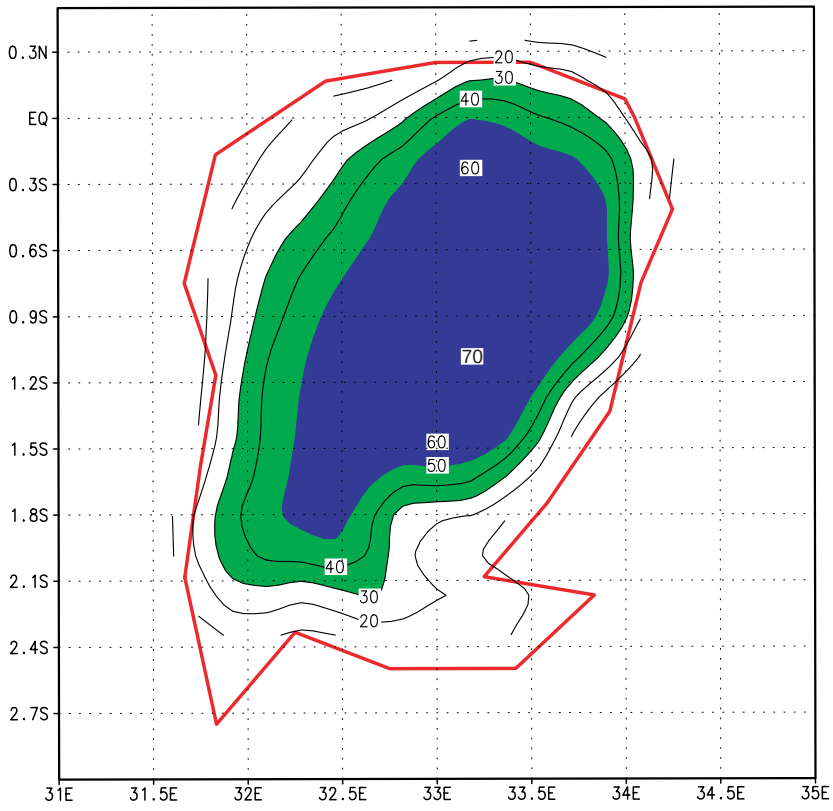



Figure 4: Depth of lake Victoria in meters.

from the food processing, textile production, leather tanning, and cement industries around the lake Victoria shores, (iii) prediction of the migration patterns of the Water Hyacinth (Eichornia Crossipes), (iv) provide marine and meteorological advisories for ship navigation, (v) guidance in the design and management of hydroelectric power plants, (vi) design of domestic water supply and irrigation schemes, and (vii) study past regional climates and thereby prepare the model for making global change projections.

We envisage that the new model has important potential applications in the study of the regional paleoclimate of lake Victoria. Several studies (Kendall, 1969; Stager et al., 1986), have shown that lake Victoria has experienced large surface water level fluctuations during the past 25,000 years. Stager and Livingstone (1986) have estimated that the water level was only 26m between 14,750 and 13,700 BP, thus nearly 50% of the present depth. Their estimates show that a 60m drop in lake level would result in a 20% decline in surface area and a 45% drop in the circumference. These paleoclimatic conditions could easily be incorporated in the new model to infer the corresponding changes in the catchment rainfall and lake circulation, and thereby provide improved interpretation of the paleoclimate theories, which have been proposed over the years.

**References**

Ba, M. B., and S. E. Nicholson, and G. T. Bates, 1998: Analysis of convective activity and its relationship to the rainfall over the Rift Valley lakes of East Africa during 1983-1990 using the METEOSAT infrared channel. J. Cli. and Appl. Met., 10, 1250-1264.

Giorgi, F., M. R. Marinucci, and G. T. Bates, 1993: Development of a Second Generation Regional Climate Model (RegCM2-EA). Part I: Boundary-layer and radiative transfer processes. Mon. Wea. Rev., 121, 2794-2813.

Giorgi, F., and O. Mearns, 1999: Introduction to special section: Regional climate modeling revisted, J. Geophys. Res., 104, NO. D6, 6335-6352.

Indeje, M., F. H. M. Semazzi and L. J. Ogallo, 1999. ENSO Signals in East African Rainfall and their Prediction Potentials. International J. Climatolol. (in press).

Kendall R. L., 1969: The ecological history of the lake Victoria basin. Ecological Monographs, 39, 121-176.

Mellor, G., 1997: User's guide for three-dimensional, primitive equation, numerical ocean model, Atmospheric and Ocean Sciences Program, Princeton University, 35pp.

Nicholson, S. E., 1996. The Limnology, Climatology and Paleoclimatology of the East African Lakes. Published by Gordon and Breach, 57pp.

Semazzi, H. F. M., N.-H. Lin, Y.-L. Lin and F. Giorgi, 1993. A CCM1-MM4 nested model study of the influence of sea-surface temperature anomalies on the Sahelian Climate. JGL, 20, 2897-2900.

Stager J. C., P. N. Reinthal, and D. A. Livingstone, 1986: A 25,000-year history for lake Victoria, East Africa, and some comments on its significance for the evolution of cichlid dishes. Freshwater Biology, 16, 15-19.

Sun, L., F. H. M. Semazzi, F. Giorgi and L. Ogallo, 1999a: Application of NCAR Regional Climate Model to eastern Africa. Part I: Simulation of the Autumn rains of 1988', J. Geophys. Res., 104, No. D6, 6529-6548.

Sun, L., F. H. M. Semazzi, F. Giorgi and L. Ogallo, 1999b: Modeling study of the interannual variability of the Autumn rains over eastern Africa', J. Geophys. Res., 104, No. D6, 6549-6562.

Yin, X., and S. E. Nicholson, and G. T. Bates, 1998: The water balance of Lake Victoria, J. of the Hydrological Sciences., 43- 789-811.

Acknowledgement: This work was supported by the Climate Dynamics Program of the National Science Foundation, USA. The contribution and participation of F. Giorgi, M. Indeje, N.-H, Lin, Y.-L. Lin, L. J. Ogallo, Y. Song, L. Sun, and L. Xie at various stages of this research is deeply appreciated.

## CLIVAR African Study Group Science Report

*Dr. Fredrick Semazzi, ICPO, Southampton, UK*

The CLIVAR African Study Group was tasked by the WCRP, through the CLIVAR SSG-7, with reviewing the state of research on African climate variability, and to develop key questions and recommendations for research to improve our understanding of the variability and predictability of the climate of Africa.

The Study group members are: M. Jury (co-ordinator), Univ. Zululand, O. Baddour - ACMAD/ Morocco, M. Harrison - UKMO, E. Poolman, South African Weather Bur., P. Lamb - Univ. Oklahoma, H. Mulenga - Zambia Met. Serv., S. Nicholson - FSU, USA, L. Ogallo - Univ. Nairobi/CLIPS, F. Semazzi - NC State Univ., J. Servain - ORSTOM France, W. Thiaw - NCEP/UCAR, Y. Tourre - IRI, L. Unganai - Zimbabwe /DMC, N. Ward - Univ. Oklahoma.

At the eighth session of SSG in May 1999, ICPO presented the full draft report for consideration by the SSG. The primary input for the report came from the CLIVAR Africa Study Group. In addition, many members of the global scientific community interested in the study of the African climate system have collaborated in the preparation of the report. Further input was provided by individuals in the context of various meetings such as the Workshop on African Climate organised by EuroCLIVAR in June 1998. The final draft of the report was submitted for external review to several leading experts in the field of African climate.

The report is organised around three central themes identified by the CLIVAR Africa Study Group: global teleconnections, continental scale processes and predictability. Chapter 1 of the report is the introduction and it provides general background information leading to the preparation of the report. It also outlines the justification for an African research focus in CLIVAR, and presents a summary of the recommendations. Chapter 2 summarises the overall scientific objectives, while Chapters 3, 4 and 5 review the state of the science in these areas and expands on the key scientific issues. Chapter 6 provides specific recommendations following from the Group's deliberations. These recommendations are grouped into the areas of modelling, empirical and diagnostic studies, observing systems, data capture and archiving, process studies and capacity building

The SSG members are reviewing the document until the end of June and the report will then guide the SSG in making recommendations for the next steps regarding the strategy of CLIVAR for Africa (G4 PRA).

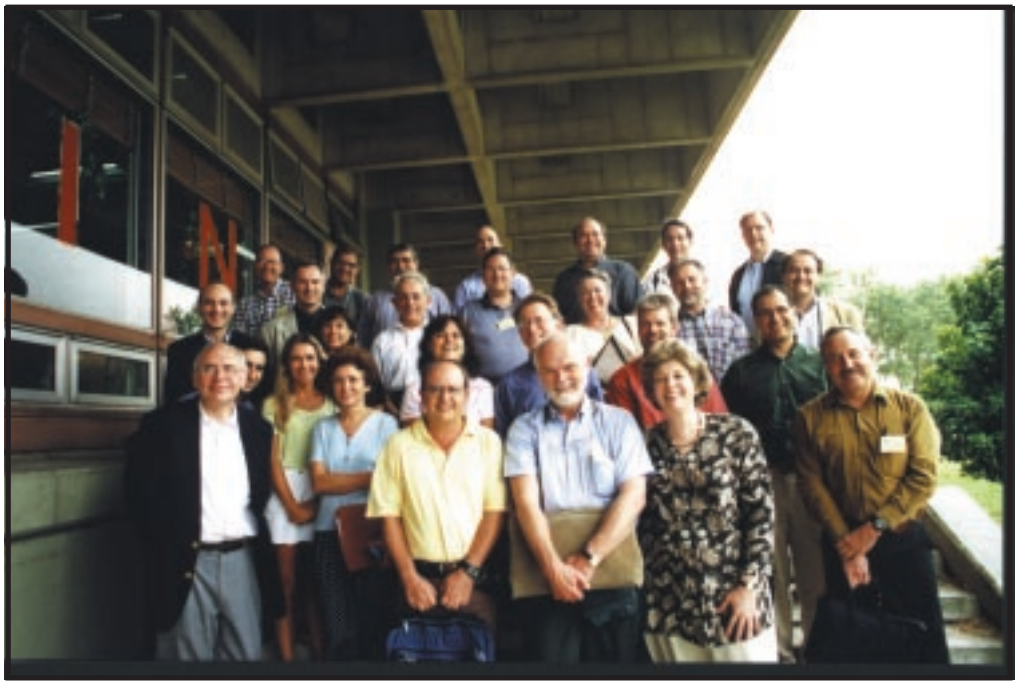
## VAMOS Panel Meeting - 2nd Session

*March 15-18, 1999, Buenos Aires, Argentina*
*C.R. Mechoso, UCLA, Los Angeles, USA*

The second meeting of the CLIVAR VAMOS Panel (VPM2) was held at the Faculty of Exact and Natural Sciences, University of Buenos Aires, Buenos Aires, Argentina, during March 15-18, 1999. About 40 participants attended the meeting, which was chaired by Professor C. R. Mechoso.

The major goals of VPM2 were to develop implementation strategies and plans for VAMOS, including field programmes on the South American monsoon systems (SAMS) and marine stratus/ stratocumulus, as well as the design concepts for a database to be used in support of VAMOS research. An important additional goal was to discuss possible ways to fund and manage an international research programme involving many countries in the Americas.

After the opening ceremony, the meeting started with a series of status reports on programmes and projects that contribute and/or co-operate with VAMOS, such as LBA (Large Scale Biosphere-Atmosphere Experiment in Amazonia), PIRATA , International Research Institute (IRI), Inter American Institute (IAI), and various French efforts. A report on the Pan American Climate Studies (PACS) included an update on EPIC (Eastern Pacific Investigation of Climate) and an overview on the U.S. CLIVAR programme beyond the year 2000. VAMOS endorses EPIC studies on the annual cycle and interannual variability of the cold-tongue/ITCZ complex (CTIC) and the subtropical stratiform cloud deck region in the southeastern Pacific. EPIC contemplates a five-year period (2000-2004) of enhanced monitoring with intensive observations in July-September 2001 and in 2003. There was also a report on the current status of the PACS data, as well as the data collection and archival activities on-going at UCAR Joint Office for Science Support and NOAA National Severe Storms Laboratory. It was felt that VAMOS could greatly benefit from the lessons learned in those on-going activities. A presentation on GEWEX and GCIP current and planned activities emphasised their strong relevance to VAMOS. For example, the proposed GEWEX American Prediction Project (GAPP) extending from 2001 to 2007 would comprise all of the United States and northern Mexico. This is of great interest to



Participants of the 2nd meeting of the CLIVAR VAMOS panel meeting in Buenos Aires, Argentina

VAMOS since the North American monsoon system is a major component of the climate in the region. Large intersects, therefore, can be expected between GAPP and VAMOS. There was general agreement on the need to co-ordinate field programmes of VAMOS and GEWEX. Of particular relevance to VAMOS is the Co-ordinated Enhanced Observing Period (CEOP) which the Science Steering Group of GEWEX is planning for in 2001-2002.

One of the central themes of VAMOS is the evolution of the South American Monsoon system (SAMS). A presentation on the activities of the VAMOS Working Group on SAMS demonstrated the significant progress made by the group in assessing the current state of knowledge on the subject, identifying gaps in this knowledge, and planning field experiments to close these gaps. The Working Group identified inadequate observations (both in quality and coverage) as well as the limited availability of historical data over South America as the current most limiting factors to adequately address the impact of climate variations (particularly in precipitation) on water resource management, energy production, agriculture and health. The recovery of precipitation and surface temperature data, which in some countries go back to the beginning of the 20th century, must be a first priority for research on SAMS. The Working Group proposed an expanded observational network to enhance monitoring of climate variability in the SAMS region, and a field experiment on the South American low-level jet, a major but largely unknown component of the flow over the continent east of the Andes. This experiment would include a preparatory phase in 2000 and an intense observing period towards the end of 2001.

Another central theme of VAMOS is the study of marine stratus/stratocumulus in the eastern Pacific. VAMOS had appointed a Working Group to develop and promote scientific activities leading to an improved understanding and model simulation of the effects of eastern Pacific stratus/stratocumulus decks on the variability of American Monsoon systems. A presentation on the activities of this group emphasised that international collaboration would greatly contribute to the success of field programmes in the eastern Pacific since there are various related national efforts that can complement each other in this region. For example, Chile is developing a South American Coastal Stratus Experiment and has an active programme with tidal stations. The Permanent Commission for the South Atlantic, involving Chile, Peru, Columbia, and Ecuador has also a proposed a moored array and a Southeast Pacific Ocean Meteorological Array.

Consistently with CLIVAR policies, the Working Group on the VAMOS database re-emphasised that VAMOS data management will be based, as far as possible, on the principle of free and open access to data. Some participants from South American countries expressed their concerns that an open data policy would be hard to meet, especially by national meteorological services for which providing data is a source of income. It was agreed that the data man-

agement might be based on distributed data centres.

Thereafter the meeting split into three break-out groups to start working on implementation strategies. The groups focused on the American low-level jets, marine stratus/stratocumulus, and VAMOS database. The group on low-level jets suggested an additional monitoring programme to determine the climatology and interannual variability of the phenomenon. The original plan to have the intense observational period in 2001 was postponed to 2003, which was regarded as more realistic (funding, logistics, etc.). Further discussions are needed in view of the potential mismatch with the proposed CEOP period. The group was asked to sharpen the focus and the justification for the programme based on the climate aspects of the phenomenon.

The group on marine stratus/stratocumulus formulated hypotheses on a connection between heating and rising motion over the Amazon basin and the Altiplano and subsidence along the Pacific coast of South America, which contributes to the existence of low level clouds in that region. Plans were presented for a coastal stratus experiment with an oceanographic focus in January-February 2001 and another two months period in August- September 2001. The second part of the stratus experiment would include studies on the atmospheric divergent motions with an upper air array and combined aircraft/ship observations, and would take place in the same time frame as the second phase of EPIC in January/February 2003. The group was recommended to broaden their view to match better with the EPIC plan, which means to include the east Pacific cold tongue and warm pool of Mexico is its scope.

The group on a VAMOS database recommended the establishment of a WWW-based Central Information Source for Data under ownership and control by an existing institution with experience on data management and mirror sites in both hemispheres. The database would not be a data archive. Rather, it would include information about VAMOS data and links to data sources. It was indicated that such an activity would require financial support, and that VAMOS should begin to establish agreements with participating countries to allow access and distribution of operational data sets prior to its first field campaign. The group encouraged the VAMOS Panel Chair to work through the WMO Secretary General and the Region II and IV Permanent Representatives to inform national centres on VAMOS activities as well as to promote full co-operation on data access.

The break-out sessions were followed by a plenary discussion on the funding and organisation of a programme as complex and multinational as VAMOS. A short presentation on the Global Environmental Facility (GEF) highlighted that this can be a source of support for VAMOS programmes. GEF is an interim funding mechanism to help developing nations address adverse climate change impact issues. In the context of VAMOS, GEF funds could be used to develop components of a climate change monitoring system for the region, which is a long-term goal of the programme. One component is a network of buoys capable of monitoring the physical, chemical and biological structure of the ocean off the west coast of South America from Colombia to the southern tip of Chile. Another component is a series of monitoring sites located within continental South America, initially forming part of the VAMOS network designed to investigate low-level jets, but additionally equipped to make carbon budget related measurements and to measure other parameters most relevant to climate change. It was agreed to start activities leading to the development of a proposal to be submitted though the World Bank, United Nations Environment Programme (UNEP) or United Nations Development Programme (UNDP). Drs. C. R. Mechoso and D. Rogers were appointed as preliminary points of contact for the overall effort.

There was a consensus on the current lack of a practical way to funnel funds from several sources to VAMOS programmes via a neutral (international) institution. The possibility was mentioned that IAI, a programme participating in VAMOS, might provide an interim solution to the problem. A possible scenario would be that VAMOS and IAI together define activities that VAMOS wishes to encourage and are also within the scientific goals of IAI. Currently IAI already funds projects relevant to VAMOS, such as climate variability in the Americas, ENSO and interannual climate variability, ocean-land-atmosphere interaction and hydrology (water resources). Other areas of common interest are comparative studies of ecosystems, biodiversity, land and water resource in the Americas, changes in the composition of the atmosphere, and integrated assessments, human dimension and applications. This role of IAI would be effective for funds provided by agencies which have traditionally funded the institute. The need for help to co-ordinate sev-

eral international activities was stated in the strongest possible terms. The role of a VAMOS Project Office discussed. It was generally felt that a co-ordination office would be of great help for the implementations of specific VAMOS projects. There was some discussion about possible locations and tasks of such an office. It was decided that the location might vary as the science focus adjusts to different field programmes. In terms of financial matters, several participants expressed concern that the ICPO and the JCRF (Joint Climate Research Fund) of WCRP have not been able to provide resources for meetings without contributions from other national funds.

Thereafter the meeting participants attended a highly interesting series of lectures by climate researchers from the Department of Atmospheric Sciences of the University of Buenos Aires. A particularly relevant lecture addressed the South Atlantic Climate Change Experiment (SACC), which is planned by scientists from Argentina, Brazil, United States and Uruguay. The primary goal of SACC is to better understand the interactive relationship of the southwestern South Atlantic sea surface temperature (SST) and the larger scale climate behaviour. The VAMOS panel is considering an endorsement of SACC, and a number of clarifications on the scientific questions to be addressed by the programme were formulated. In general, the presentations demonstrated the very high level and relevance to VAMOS of climate research performed in Argentina..

The meeting participants strongly agreed that CLIVAR/VAMOS is uniquely placed to make major contributions towards the understanding of the processes that contribute to climate variability in the Americas, and to provide guidance and co-ordination in the development of observational systems that can be used to help mitigate deleterious effects of climate change on nations of South America. There was a consensus on the interest and readiness of the countries in the region to embark and support collaborative research on the American monsoon systems. Such readiness is partly due to the enhanced regional awareness on the potential benefits that will come from a better prediction of climate variability.

The next panel meeting was tentatively fixed for April 2000 in Santiago, Chile, together with the 6th Conference on Southern Hemisphere Meteorology and Oceanography of the American Meteorological Society.

## Upper Ocean Panel - 4th Session

*May 17-21, 1999, Woods Hole, MA, USA,*
*A. Villwock (ICPO), C. Koblinsky (NASA/GSFC)*

The CLIVAR Upper Ocean Panel (UOP) and the GCOS/GOOS Ocean Observations Panel for Climate (OOPC) jointly met at Woods Hole Oceanographic Institution (WHOI) from May 17 - 21. The chairs of the UOP, Dr. C. Koblinsky, and the OOPC, Dr. N. Smith, welcomed about 35 participants attending this first joint meeting of the two panels. The main agenda item for this meeting was the preparation for the conference on the Ocean Observing System for Climate (OceanObs99) to be held in Saint Raphael, France, October 18 to 22.

The major mission of the Conference is to define the optimum mix of measurements needed to meet the goals of climate programmes such as CLIVAR, GCOS, and GOOS. The Conference will review current scientific climate programme priorities, and existing and planned observational efforts that address those priorities. This review will serve as the basis for establishing community consensus on the most viable candidate technologies and implementation strategies for implementing a comprehensive, integrated global, international climate observing system in support of research, forecasting, and climate assessment.

The participants reviewed the current status of all invited presentations on the conference agenda as presented by the lead authors or by dedicated representatives. It was concluded that the scientific organising committee will work with the lead authors to ensure that an overall coherent picture about the envisioned ocean observing system will be presented at the conference and contained in the conference statement. All interested scientists are welcomed to visit the conference web site at **http://OCEANOBS99.cls.fr/** and to submit abstracts until end of June.

In addition, the panels discussed methods to implement the proposed global array of profiling floats (ARGO), and the potential role of new measurement technologies such as acoustic tomography and autonomous submarine vehicles.

The possible data management structures to handle oceanographic data from various sources to fulfil the demands of the (quasi)-operational and the research community were presented. Furthermore,

the use of global numerical models to synthesise the observations and test the sensitivity to various observations and sampling schemes were outlined and discussed.

In an invited presentation Dr. R. Schmitt (WHOI) described preliminary results from profiling floats in the tropical North Atlantic that can be regarded as a testbed for the ARGO programme. Thereafter the panel discussed with Dr. R. Weller (WHOI) the role of time series stations and flux measurements for CLIVAR related scientific issues. The panel concluded to review this part of the ocean observing system, as well as the methods of observation synthesis, in greater detail at their next meeting.

## Report of the 6th Meeting of PIRATA Steering Group

*May 3-4, 1999, Miami, FL, USA*
*I. Wainer (USP, São Paulo, Brazil), J. Trotte (GOOS Project Office, Paris, France)*

The sixth meeting of the PIRATA (Pilot Research Moored Array in the Tropical Atlantic) Steering Committee, hosted by NOAA/AOML and partially supported by IOC/GOOS, was held in Miami, FL, on May 3-4, 1999. The meeting was followed by the Workshop on Climate Observation Systems in the Tropical Atlantic (COSTA).

PIRATA-6 was mainly devoted to discuss the status of the national (Brazil, France, U.S.A.) past and present contributions to PIRATA, evaluation of the first 18-month PIRATA data, their contribution to our knowledge of the climate variability in the region, deployment schedules and maintenance of the PIRATA array, as well as possible expansions of the PIRATA "pilot" array.

The first phase of PIRATA implementation coincided with a warm event which occurred in the whole tropical Atlantic. That dramatic event developed during the end of the largest ENSO event ever registered and was concomitant with one of the five worst droughts in NE Brazil this century. The buoy array captured the development of the upper ocean thermal anomalies, and the seasonal evolution of oceanic and atmospheric variability on which they were superimposed. Real-time PIRATA data available on the GTS were used in operational oceanic and atmospheric analyses and forecasts during this period. Preliminary diagnosis of the data also supports hypotheses concerning ocean-atmosphere coupling in the region.

The PIRATA Steering Group reviewed the progress in the implementation of the array. The deployment of the moored buoy array began in late 1997, and by early May 1999 nine sites were occupied and successfully transmitting data in real-time. Implementation is on schedule and nearly complete. The full array of 12 moorings will be in place for one year before the field phase is scheduled to end in early 2001.

PIRATA was originally conceived as a pilot study with a 3-year field phase in support of CLIVAR, GCOS, and GOOS objectives. It became clear that the data set coming from the array, not yet fully completed, had insufficient to evaluate whether PIRATA should switch to a full operational mode at this stage. On the other hand, it is clear that PIRATA data are already providing valuable new information for climate studies of great relevance to climate prediction in the Americas and Africa.

Based on the initial successes of the programme, the PIRATA Steering Group recommended a transitional phase towards the development of a sustained climate observing system for an additional five years, until 2006. This extension until 2006 will allow for a full demonstration of the utility of PIRATA data, and a smoother transition to operational status, if warranted.

In addition, recognising that this extension will require a sustained level of support in terms of funding, ship-time, and equipment, the PIRATA Steering Group recommends that a PIRATA Resource Board be established, to ensure that adequate resources will be available for the duration of the programme. This Resource Board would initially consist of representatives from the institutions in Brazil, France and the United States that presently provide support for the array.

Finally, in recognition of the already shown interest in developing a sustained observing system in the tropical Atlantic for climate studies, as evident from the many mentions to the programme in scientific meetings, the PIRATA Steering Group resolved to co-ordinate with ongoing and planned observational efforts in the region. Furthermore, building upon recommendations put forward at the COSTA workshop, the Steering Group encourages consideration of scientifically sound pilot expansion projects that build upon the original PIRATA array. Moreover, the Steering Group invites collaborations with other nations and institutions interested in implementing a sustained climate observing system in the tropical Atlantic, especially through PIRATA co-sponsors.

## CLIVAR Calendar

| 1999 | Meeting | Location | Attendance |
|---|---|---|---|
| July 19 - 30 | IUGG/IAPSO | Birmingham, UK | Open |
| August 23 - 27 | 2nd International Conference on Reanalysis | Reading, UK | Open |
| August 23 - 27 | WOCE North Atlantic Workshop | Kiel, Germany | Limited |
| September 13 - 17 | 4th Conference on Modelling of Global Climate Change and Variability | Hamburg, Germany | Open |
| September 13 - 17 | 8th Conference on Climate Variations | Denver, USA | Open |
| September 20 - 22 | JSC/CLIVAR Working Group on Coupled Modelling - 3rd Session | Hamburg, Germany | Invitation |
| October 4 - 8 | WOCE SSG - 26th Session | La Jolla, USA | Invitation |
| October 18 - 22 | OOPC/CLIVAR Conference on Ocean Observations for Climate | Saint Raphael, France | Open |
| October 27 - 29 | US-CLIVAR SSC, 4th Session | Irvine, USA | Invitation |
| November 8 - 12 | PAGES/CLIVAR Meeting | Venice, Italy | Invitation |
| December 6 - 10 | CLIVAR Asian-Australian Monsoon Panel, 3rd Session | Honolulu, USA | Invitation |
| December 13 - 17 | AGU Fall Meeting | San Francisco, USA | Open |
| **2000** | **Meeting** | **Location** | **Attendance** |
| January 8 - 15 | 80th AMS Annual Meeting | Long Beach, USA | Open |
| February 7 - 11 (to be confirmed) | CLIVAR Scientific Steering Group, 9th Session | Melbourne, Australia | Invitation |
| April 3 - 7 | 6th International Conference on Southern Hemisphere Meteorology and Oceanography | Santiago, Chile | Open |

For more information, please contact the ICPO or check out our web-page: **http://www.dkrz.de/clivar/latest.html**

Please return to the International CLIVAR Project Office by mail or email (**icpo@soc.soton.ac.uk**)

Special requests:

☐ Change of address ☐ Remove as recipient

☐ Please send *CLIVAR-Exchanges* to the following address:

Name: _____
(Title) (First) (M.I.) (Last)

Organization: _____

Mailing address: _____

City: _____ State: _____ Zip: _____ Country: _____

Telephone: _____ Fax: _____

E-mail address: _____

*CLIVAR - Exchanges*

Newsletter of the Climate Variability and Predictability Programme (CLIVAR), published by the International CLIVAR Project Office, Southampton Oceanography Centre, Empress Dock, Southampton, SO14 3ZH, United Kingdom, Phone: +44 (0) 2380 596777, Fax: +44 (0) 2380 596204, e-mail : icpo@soc.soton.ac.uk

**Note: New phone numbers from June 1, 1999: Old ICPO number: +44 (0) 1703 596777 will also be accessible until Autumn 2000.**

**ISSN No.: 1026 - 0471**